Remarks

Applicants acknowledge with appreciation the acceptance of the preliminary amendment filed 12/13/01 (paper #4) and the entering of all claims in entirety. Applicants attach herewith the appropriate fee for the additional independent claims added as discussed hereinafter. If additional fees are required, the Commissioner is hereby respectfully authorized to deduct such fees from Deposit Account Number 13-2166.

In the Specification

Applicants respectfully request that these amendments be entered in their entirety as they are a correction of inadvertent errors or clarifications and not an attempt to introduce new matter.

Election/Restrictions

Applicants respectively affirm the election, made by William Johnson during a telephone conversation with Zakiya N. Walker on 8/12/02, made without traverse to prosecute the invention of group II, claims 6-25 and 36-67. Therefore, please withdraw claims 1-5 and 26-35 from further consideration in light of the restriction election.

Drawings:

The substitute drawings, three (3) sheets comprising seven (7) figures, are being sent under separate cover letter to the Patent Office Draftsman. Figs. 3, 4, 5, 6, 7, 8, and 9 have been rotated 180 degrees and repositioned on their respective pages to clarify which end is designated top and which is bottom. The specification and the claims distinctly point out that the moveable inner tubular is engaged in a first position while the tool is run downhole. This first position is further described as one in which the one or more valves are held in the open position. The inner tubular is moved to a second position, by applying pressure to a drop member, which pushes the inner tubular into its second position. In this second position, the inner tubular uncovers the valves and is no longer engaged in them. It is clear that device shown in the drawings can only have one top end and one bottom end in order to function as described in the claims and specifications. Therefore, the mere rotation and repositioning of the drawings is not a

presentation of any new matter or disclosure but is only intended to provide clarity and ease of reading.

Claim Objections

Claims 43-46 are objected to for an inconsistent term. The particular term, in claim 43, has been corrected in accord with the examiner's suggestions. It is thus submitted that claims 43-46 are now patentable and should be allowed.

Claim Rejections – 35USC § 112

Claims 8 and 50-52 stand rejected under 35 U.S.C 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regards as the invention. In particular, the examiner is correct that claim 8 should depend from claim 7 and not claim 6 as stated by the Applicants. We appreciate the examiner's notification and have amended this claim accordingly. Claims 50-52 are also rejected due to a lack of an antecedent basis due to an inadvertent omission of a term in parent claim 49. Again, Applicants appreciate the examiner's notice of omission and have amended claim 49 accordingly.

Claim Rejections – 35USC § 102(b)

Claims 6-8, 10-12, and 17-25 stand rejected under 35 U.S.C 102(b) as being anticipated by Freeman '241 (cited by Applicants). This rejection is respectfully traversed.

In Freeman, the inner tubular member extends only partially through the bore and does not insulate either of the two Freeman valves or the associated valve seats from fluid flow as required by amended claim 6. In the Applicants' device, the one or more valves are insulated from fluid flow when the inner and outer tubular members are in the first position as per claim 6. Thus, the valve disc and seat are insulated from damage caused by bore fluid flow. The positioning of the valve seats between the inner and outer member as specified in claim 7 is also not shown by Freeman. Because Freeman does not insulate the one or more valves or valve seats from fluid flow, it is also readily apparent that Freeman also does not seal off the one or more

valves or valve seats from fluid flow as per amended claim 19.

Neither Freeman nor any of the cited prior art discloses the particular mounting of the drop member adjacent to the moveable member as per claim 17. Instead Freeman teaches that the drop ball is dropped from the surface. In Applicants' device, if desired, the drop ball can be mounted in the assembly and lowered therewith because in one possible embodiment the ball can be mounted adjacent the moveable member as per claim 17.

Freeman does not disclose blocking down jets to prevent cement flow therethrough as per amended claim 22. Applicants respectfully submit Freeman does not show any jets. However, to the extent that the opening in the bottom of Freeman that is controlled by the flapper valves might possibly be considered a down jet, note that any cement flow pumped through the tubular string as is normal cementing practice will immediately open both flapper valves 66 and 172 and permit cement flow therethrough in contradiction to the amended claim language.

Claims 19-25, 36-41, 43, and 46 stand rejected under 35 U.S.C 102(b) as being anticipated by Blizzard et al '067. This rejection is respectfully traversed.

As per amended claim 19, Blizzard does not show sealing off the Blizzard flapper valve 26. Instead Blizzard intentionally permits fluid flow around the Blizzard flapper valve 26. See Blizzard Col. 4, lines 20-24.

Blizzard does not teach pumping into the string through one or more down jets while installing the tubular string as per amended claim 22. Actually, there is no flow communication between the Blizzard the down jet 89 as noted in the Office Action and the inside of the tubular string so it would not be possible to pump through jet 89 as described in this step. Blizzard teaches pumping into the annulus to force fluid through jet 89, instead of pumping into the tubular string as per the claim language. In fact jet 89 is permanently blocked with respect to pumping into the tubular string. In any event, Blizzard has nothing to do with pumping cement, and does not ever prevent cement flow through jet 89, and so is actually irrelevant to claim 22. For that matter, pumping cement through the Blizzard tool would permanently ruin the Blizzard tool.

Blizzard does not fairly teach releasing a drop member as per claim 25. The shift tool

for profile 80 is not released as per the claim language but instead is supported by wireline and must be raised during operation and then lifted out of the wellbore. See Blizzard Col. 5, lines 19-30. For this same reason of the shift tool, Blizzard does not teach a sleeve that can be moved one time only as per amended claims 36 and 43 because by use of the shift tool, the Blizzard sleeve can be repeatably operated.

As per claim 40, Blizzard has nothing to do with cementing a tubular string into a wellbore. Therefore, Blizzard also does not have any mechanisms for controlling fluid flow for washing through down jets and then for blocking the fluid flow for down jets while opening the up jets to direct cement therethrough as per the amended claim 40 language.

Claims 36, 37, 40, 41, 43, 45, and 46 stand rejected under 35 U.S.C 102(b) as being anticipated by Davis '130 (cited by Applicant) or Tailby '819. This rejection is respectfully traversed. The moveable member, or shuttle valve 12, of the Tailby washing tool oscillates during operation. See Tailby Col. 4, lines 43-55. Thus, Tailby does not disclose a moveable member that is moveable from a first position to a second position one time only as per amended claims 36 and 43. Likewise, the moveable member 38 of Davis is moveable more that one time as illustrated in Davis Fig. 4- Fig. 6 whereby moveable member 38 is repeatedly moveable utilizing overshot 64 for engaging dart valve 58 to reset member 38 to its original position for operation at the next perforation zone to be washed.

As per claims 40, neither Tailby nor Davis show a moveable member for directing fluid flow for washing through down jets and cement through up jets. Actually, neither Tailby nor Davis is operable for cementing tubulars to which they are mounted into the wellbore. Therefore, Tailby and Davis have essentially nothing to do with Applicants' float tool. Both the Tailby and Davis tool are for washing and, like Blizzard, would be ruined if cement were pumped therethrough.

Claims 13, 17, 18, 22-25, 36, and 40-46 stand rejected under 35 U.S.C 102(b) as being anticipated by Ross et al '045. This rejection is respectfully traversed.

Ross has nothing to do with cementing a tubular string into the wellbore. In fact, the screen or slotted liner S of Ross would be ruined if it were cemented in position. Thus, Ross does not disclose a tool for cementing a tubular string and having up jets for directing the cement

during cementing as per amended claim 13. Since Ross has nothing to do with cementing, Ross cannot teach blocking a down jet to prevent cement flow therethrough as per amended claim 22 or to direct cement through up jets as per amended claim 40.

The Ross drop ball B is dropped from the surface through working string 18 instead of being mounted adjacent the moveable member as per claim 17.

The Ross moveable member 520 is biased by spring 526 and can be repeatedly opened and closed by applying and releasing fluid pressure for washing. See Ross Col. 11, lines 45-55. Thus, the Ross moveable member 520 is not moveable one time only as per amended claims 36 and 43.

Double Patenting

Claims 47 is rejected under the judicially created doctrine of obviousness-type double patenting. This rejection is based upon claim 11 of The Applicants' own U.S. Patent No. 6,401,824. A Terminal Disclaimer which is believed to be in compliance with 37 C.F.R. 1.321(c) is enclosed which is believed to overcome the rejection based upon double patenting.

Allowable Subject Matter

Applicants note with appreciation the allowance of claims 57-67. Applicants also note with appreciation the indication of patentability of claims 9, 14-16, 48, 49, and 53-56 if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Applicants believe that the rejection to claim 6 has been overcome above. Since claim 6 is believed to be in formal condition for allowance, this should also overcome the objection to claim 9 as being dependent upon a rejected claim. Therefore, Applicants respectfully submit that claim 9 now stands in formal condition for allowance without any further revision. As suggested, claims 14-16 have been re-written in independent form including all of the limitations of the base claim and any intervening claims. Claims 48, 49, and 53-56 were dependent upon base claim 47.

Applicants believe that the rejection of claim 47, based on the judicially created doctrine of obviousness-type double patenting has been overcome. Since claim 47 is now believed to stand in formal condition for allowance, this should also overcome the objection to claims 48, 49, and 53-56 as being dependent upon a rejected claim. Therefore, Applicants respectfully submit that claims 48, 49, and 53-56 now stand in formal condition for allowance without any further revision.

Applicants further note with appreciation the indication of allowance of claims 50-52 if rewritten to overcome the rejection(s) under 35 U.S.C. 112, second paragraph. Applicants believe that they have complied with the corrections as set out by the examiner in paragraph 16 of this Office Action. Therefore, by correcting claim 49, as set out, by the examiner, in paragraph 16, Applicants have overcome the objections to claims 49-52 and now respectfully submit that claims 50-52 now stand in formal condition for allowance.

Conclusion

In light of the above discussion, Applicants respectfully submit that the application now stands in formal condition for allowance.

Respectfully submitted,

Guy E. Matthews
Reg. No. 24,173

Date: 12/8/02

The Matthews Firm
1900 West Loop South, Suite 1800
Houston, TX 77027-3214
(713) 355-4200 - Telephone
(713) 355-9689 - Facsimile

Clean Claims

CLAIMS

What is claimed is:

1. Deleted

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6. Float collar/ shoe equipment for use in lowering a tubular string into a wellbore, said equipment comprising:

an outer tubular member and an inner tubular member moveable between a first position and a second position;

one or more valves positioned between said outer tubular member and said inner tubular member when said inner tubular member is in said first position; and

said one or more valves being insulated from fluid flow in said first position and being selectively engageable with fluid flow in said second position.

7. Float collar/ shoe equipment of Claim 6, further comprising:

one or more valve seats positioned between said outer tubular member and said inner tubular member.

8. Float collar/ shoe equipment of Claim 7, wherein said inner tubular member is moveable with respect to said outer tubular member from said first position to a second position for uncovering said valves and said valve seats.

9. Float collar/ shoe equipment of Claim 6, wherein said outer tubular member defines one or more passageways therethrough which are blocked by said inner tubular member in said first position, said one or more passageways being opened to permit fluid flow from within said tubular string to outside of said tubular string when said inner tubular member is moved from said first position to a second position.

10. Float collar/ shoe equipment of Claim 6, further comprising a seat secured to said inner tubular member for receiving a drop member.

11. Float collar/ shoe equipment of Claim 6, wherein said one or more valves comprises a plurality of flapper valves.

12. Float collar/ shoe equipment of Claim 6, wherein said one or more valves are held in an open position when said inner tubular member is in said first position.

13. Float collar/ shoe equipment operable for use in lowering a tubular string into a wellbore prior to cementing said tubular string within said wellbore, said tubular string having an inside and an outside external to said inside, said well equipment comprising:

an outer tubular member forming a portion of said tubular string and having at least one up jet therein for directing pumped cement in an up hole direction during said cementing of said tubular string within said wellbore, each of said at least one up jets providing a passageway between said inside and said outside of said tubular string; and

a moveable member, said moveable member being mounted to block fluid flow through said at least one up jet in a first position, said moveable member permitting said pumped cement to flow through said up jet in a second position.

14. Float collar/ shoe equipment operable for use in lowering a tubular string into a wellbore, said tubular string having an inside and an outside external to said inside, said well equipment comprising:

an outer tubular member forming a portion of said tubular string and having at least one up jet therein, each of said at least one up jets providing a passageway between said inside and said outside of said tubular string;

a moveable member, said moveable member being mounted to block fluid flow through said at least one up jet in a first position, said moveable member permitting fluid flow through said up jet in a second position; and

at least one down jet, wherein said moveable member is mounted to permit fluid flow through said at least one down jet in said first position, said moveable member being mounted to block fluid flow through said at least one down jet in said second position.

15. Float collar/ shoe equipment operable for use in lowering a tubular string into a wellbore, said tubular string having an inside and an outside external to said inside, said well equipment comprising:

an outer tubular member forming a portion of said tubular string and having at least one up jet therein, each of said at least one up jets providing a passageway between said inside and said outside of said tubular string;

a moveable member, said moveable member being mounted to block fluid flow through said at least one up jet in a first position, said moveable member permitting fluid flow through said up jet in a second position; and

one or more valve seats, said one or more valve seats being insulated from fluid flow in said first position and being selectively engageable with fluid flow in said second position.

16. Float collar/ shoe equipment operable for use in lowering a tubular string into a wellbore, said tubular string having an inside and an outside external to said inside, said well equipment comprising:

an outer tubular member forming a portion of said tubular string and having at least one up jet therein, each of said at least one up jets providing a passageway between said inside and said outside of said tubular string;

a moveable member, said moveable member being mounted to block fluid flow through said at least one up jet in a first position, said moveable member permitting fluid flow through said up jet in a second position; and

one or more valves for operation with said one or more valve seats.

17. Float collar/ shoe equipment operable for use in lowering a tubular string into a wellbore, said tubular string having an inside and an outside external to said inside, said well equipment

comprising:

a moveable member operable for selectively controlling fluid flow through one or more jets, said jets directing fluid from said inside of said tubular string to said outside of said tubular string; and

a drop member mounted adjacent to said moveable member, said drop member being operable in response to fluid pressure for engaging said moveable member.

18. Float collar/ shoe equipment of Claim 17, further comprising one or more valves, said moveable member being operable for activating said one or more valves for controlling fluid flow through said tubular string.

19. A method for completing a well operable for use in lowering a tubular string into a wellbore, said tubular string having an inside and an outside external to said inside, said method comprising:

sealing off one or more valves from fluid flow through said tubular string such that said valves are held in an open position; and

selectively uncovering said valves for controlling fluid flow through said tubular string.

20. The method of Claim 19, wherein said step of selectively uncovering further comprises dropping a member into said tubular string.

21. The method of Claim 19, further comprising:
selectively closing one or more passageways between said inside of said tubular string and said outside of said tubular string.

22. A method for a well for use in installing a tubular string into a wellbore by cementing said tubular string into said wellbore, said tubular string having an inside and an outside external to said inside, said method comprising:

pumping cement into said tubular string and through one or more down jets while installing said tubular string into said wellbore; and

selectively blocking said one or more down jets to prevent cement flow through said one or more down jets during said cementing of said tubular string into said wellbore.

23. The method of Claim 22, further comprising:
selectively blocking one or more up jets.

24. The method of Claim 22, further comprising:
selectively exposing one or more check valves to fluid pressure.

25. The method of Claim 22, wherein said step of selectively blocking further comprises releasing a drop element to thereby slide a moveable member.

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36. Well equipment operable for use in lowering a tubular string into a wellbore, said tubular string having an inside and an outside external to said inside, said well equipment comprising:
an outer tubular member forming a portion of said tubular string and having at least one

down jet therein, each of said at least one down jets providing a passageway between said inside and said outside of said tubular string; and a moveable member, said moveable member being moveable one time only from a first position to a second position, said moveable member being mounted to permit fluid flow through said at least one down jet in said first position, said moveable member being mounted to block fluid flow through said at least one down jet in said second position.

37. The well equipment of Claim 36, further comprising:

at least one up jet, said moveable member being mounted to block fluid flow through said at least one up jet in said first position, said moveable member permitting fluid flow through said up jet in said second position.

38. The well equipment of Claim 36, further comprising one or more valve seats, said one or more valve seats being insulated from fluid flow in said first position and being selectively engageable with fluid flow in said second position.

39. The well equipment of Claim 38, further comprising one or more valves for operation with said one or more valve seats.

40. Well equipment operable for use in installing a tubular string into a wellbore by cementing said tubular string into said wellbore, said well equipment comprising:

one or more up jets formed in said tubular string;

one or more down jets formed in said tubular string; and

one or more moveable members, said one or more movable members being operable for selectively controlling fluid flow through at least one said one or more down jets for washing, and for blocking said at least one or more down jets while directing cement flow through said one or more up jets for said cementing of said tubular string into said wellbore.

41. The well equipment of Claim 40, further comprising:

one or more moveable members, said one or more movable members being operable for selectively controlling fluid flow through at least one of said one or more up jets and said one or more down jets.

42. The well equipment of Claim 40, further comprising:

one or more float valves to prevent reverse flow through said tubular string.

43. Well equipment operable for use in lowering a tubular string into a wellbore, said well equipment comprising:

one or more first jets formed in said tubular string;

one or more second jets formed in said tubular string; and

one or more moveable members, said one or more moveable members being operable one time only for selectively opening said one or more first jets for fluid flow therethrough and for closing said one or more second jets to prevent fluid flow therethrough.

44. The well equipment of Claim 43, further comprising:

one or more float valves to prevent reverse flow through said tubular string.

45. The well equipment of Claim 43, wherein said one or more first jets are up jets.

46. The well equipment of Claim 43, wherein said one or more second jets are down jets.

47. A float equipment assembly for lowering a tubular string from a surface position into a wellbore, said assembly comprising:

an outer tubular affixed to said tubular string;

a first flapper valve body mounted within said outer tubular, said first flapper valve body defining a first bore therethrough;

a first flapper closure element pivotally mounted to said first flapper valve body for pivotal movement between an open position and a closed position, said first flapper closure element being selectively operable between an auto-fill mode and a back pressure mode, in said auto-fill mode said first flapper closure element being secured in said open position to permit fluid flow through said first bore in a direction toward said surface position and also to permit fluid flow in a direction away from said surface position, in said back pressure mode said first flapper closure element being pivotally moveable between said open position and said closed position responsively to fluid flow direction and being mounted to thereby prevent fluid flow

through said first bore in said direction toward said surface position and to permit fluid flow in said direction away from said surface position;

a second flapper valve body mounted within said outer tubular, said second flapper valve body defining a second bore therethrough;

a second flapper closure element pivotally mounted to said second flapper valve body for pivotal movement between an open position and a closed position, said second flapper closure element being selectively operable between said auto-fill mode and said back pressure mode, in said auto-fill mode said second flapper closure element being secured in said open position to permit fluid flow through said second bore in said direction toward said surface position and also to permit fluid flow in said direction away from said surface position, in said back pressure mode said second flapper closure element being pivotally moveable between said open position and said closed position responsively to fluid flow direction and being mounted to thereby prevent fluid flow through said second bore in said direction toward said surface position and to permit fluid flow in said direction away from said surface position; and

an inner tubular having an inner tubular flow path therethrough, said inner tubular being initially securable at a first axial position with respect to said outer tubular, in said first axial position said inner tubular being mounted to extend simultaneously through both said first bore and said second bore to thereby secure said first flapper closure element in said open position for operation in said auto-fill mode and to secure said second flapper closure element in said open position for operation in said auto-fill mode, said inner tubular being axially moveable from said first axial position away from said first flapper valve body and said second flapper valve body to thereby release said first flapper closure element for operation in said back pressure mode and also to release said second flapper element for operation in said back pressure mode.

48. The assembly of claim 47, further comprising:

a drop member receptacle mounted to said inner tubular, said drop member receptacle being operable for catching a drop member, said drop member receptacle being positioned to restrict fluid flow through said inner tubular flow path when said drop member is caught in said drop member receptacle.

49. The assembly of claim 48, further comprising:

at least one mounting member for securing said inner tubular in said first axial position,

said at least one mounting member being responsive to a first selected fluid pressure to release said inner tubular when said drop member is caught in said drop member receptacle.

50. The assembly of claim 49, wherein said at least one release member is breakable in response to said first selected fluid pressure.

51. The assembly of claim 49, further comprising:

a fluid pressure-operated tool mountable to said tubular string for operation at a second selected fluid pressure, said second selected fluid pressure being different than said first selected fluid pressure.

52. The assembly of claim 51, wherein said second selected fluid pressure is less than said first selected fluid pressure.

53. The assembly of claim 48, wherein said inner tubular flow path has a sufficient internal diameter to permit a drop member, having an outer diameter which is less than the internal diameter of the inner tubular, to move into said inner tubular flow path.

54. The assembly of claim 47, wherein each of said first flapper valve body, said first flapper closure element, said second flapper valve body, second flapper closure element are comprised of a drillable material.

55. The assembly of claim 47, wherein a portion of said outer tubular has an axial length in which is contained each of said first flapper valve body, said first flapper closure element, said second flapper valve body, said second flapper closure element, and said inner tubular when mounted at said first axial position, said outer tubular within said axial length comprising a cylindrical wall structure with no apertures or uncoverable apertures therein that permit fluid flow from inside of said outer tubular to outside of said outer tubular.

56. The assembly of claim 47, further comprising:

at least one shoulder formed on said outer tubular for engaging and supporting at least one of said first flapper valve body or said second flapper valve body with respect to said outer

tubular.

57. A method for running a tubular string from a surface position into a wellbore and for cementing said tubular string within said wellbore, said method comprising:

mounting a plurality of flapper valves in a float equipment tubular attached to said tubular string;

covering said bore of said plurality of flapper valves by extending a tubular through all of said plurality of flapper valves;

running said tubular string with said float equipment tubular into said wellbore such that ~~said~~ wellbore fluid flows inwardly into said tubular string through said plurality of flapper valves; and

removing said tubular from said plurality of flapper valves such that said flapper valves are pivotal to thereby open in response to a direction of fluid flow away from said surface position and to close in response to a direction of fluid flow towards said surface position.

58. The method of claim 57, wherein said step of removing said tubular further comprises:

pumping a drop member into said tubular.

59. The method of claim 58, further comprising:

seating said drop member in said tubular, and

utilizing a fluid pressure acting on said drop member to remove said tubular from said plurality of flapper valves.

60. The method of claim 59, further comprising:

breaking a breakable member.

61. The method of claim 57, further comprising:

providing said drop member with a diameter of at least two inches.

62. The method of claim 57, further comprising:

forming said plurality of flapper valves from a drillable material.

63. The method of claim 57, further comprising:

providing said plurality of flapper valves with an outer diameter substantially equal to an inner diameter of said float equipment tubular such that said outer diameter of said flapper valves engages said inner diameter of said float equipment.

64. The method of claim 63, further comprising:

providing a shoulder in said float equipment tubular for securing said plurality of flapper valves in position therein.

65. The method of claim 57, further comprising:

providing each of said plurality of flapper valves with a bore greater than two inches in diameter; and

providing that said tubular extending through said plurality of flapper valves has a tubular bore with an inner diameter greater than two inches.

66. The method of claim 57, further comprising:

sealing off said plurality of flapper valves utilizing said tubular and at least one seal between said tubular and said float equipment tubular.

67. The method of claim 57, further comprising:

providing an opening through said plurality of flapper valves sized to reduce surge pressure.

Marked up Specifications Sheets

MULTI-PURPOSE FLOAT EQUIPMENT AND METHOD

RELATED APPLICATIONS

This application is a continuation-in-part of United Sates Patent Application Serial Number 09/524,117, filed 13 March 2001 and issued as U.S. Patent No. 6,401,824 on June 11, 2002.

BRIEF DESCRIPTION OF THE PRIOR ART

For instance, in vertical or horizontal boreholes, or sections of a well having vertical and horizontal boreholes, one or more casing strings may be lowered into the hole and anchored therein by pumping a column of cement into the annulus between the casing string and the wall of the borehole. When lowering casing/liner into the wellbore, it has become conventional practice to fill the casing/liner string with drilling fluid. However due to the [weight of] volume displaced by the tubular string, surge pressure is created during the process of lowering the casing into the fluid filled wellbore. The surge pressure may damage the formation as fluid is highly compressed and forced into the formation. The surge pressure may be especially great when running close tolerance casings or liners. While devices have been used to permit fluid flow into the casing as it is lowered to thereby reduce surge pressure, problems may still occur due to limited internal casing diameters that restrict the volume of fluid flow and/or restrictions in the casing internal diameter due, for instance, to the internal diameter of float valves in the float equipment. Moreover, cuttings from the well bore may collect and bridge, for instance adjacent restrictions in the casing string, to create additional problems. Moreover, damage may occur to internal elements such as hydraulically activated liner hanger equipment, float valves, sealing elements such as seats for the float valves, or other elements, due to the abrasive fluids or cuttings from the wellbore that flow into the casing string.

SUMMARY OF THE INVENTION

Thus, the apparatus of the present invention may comprise a float shoe or float collar that incorporates a check valve, or a plurality of such valves, which can allow the casing to fill up from the bottom with well fluid (auto fill) during run in. Below the valve, or valves, may be a center outlet hole as well as both upwardly and downwardly facing jets. In one embodiment, a tube inside the float shoe holds the flapper or check valve(s) open to allow fluid into the casing or to permit circulation. This same tube also covers and closes a set of upwardly facing jets during run in. The downwardly facing jets are open to aid in washing the borehole wall during the casing run in or float in. Once the casing string has reached the desired depth, a drop member such as an obscuration ball may be pumped down the casing. The ball seats in the float shoe or float collar tube. With an increase in pumping pressure from the surface, the seated ball then causes the float shoe or float collar tube to move downwardly inside the tool. The downward movement allows the check valve(s) or flappers to swing closed, thus activating the check valve(s). When the tube shifts downwardly it closes and shuts off the downwardly facing jets and exposes, or opens, the upwardly facing jets to assist in cement distribution, during the cementing operation, to all sides of the casing.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

At some time during the well completion operation, it may be desirable to drill out tool 14. Therefore, conversion tool 14 should preferably be comprised of drillable materials. As well, the mounting of conversion tool 14 within pipe 21, which may effected in different ways, should preferably be drillable such as with a drill bit that may also be used for continuing to drill into the well bore formation. Generally, the drill bit will be as large as practical to fit through casing 21 and may have an outer diameter within one-quarter inch of the inner diameter of casing 21. In this example, tool 14 may be cemented, molded, or otherwise mounted within a short piece of pipe 21. Materials such as cement, concrete, plastics, aluminum, and the like which are easily drillable may be utilized for mounting tool 14 within pipe 21. In FIG. 2, details of one possible installation of tool 14 within short pipe section 21 are shown. Short pipe section 21 may be provided with interior teeth, grips, ridges, threads, roughed region, or grooves 26 to enhance attachment of material 21A to pipe 21. Material 21A may include any material useful in providing a sturdy but drillable attachment between tool 14 and pipe 21 such as but not limited to cement, plastics, glues, composite materials, elastomerics, fibers, or combinations of the above, or other suitable materials Thus, cylindrical body member 25 of tool 14 is held in place by material 21A and/or other attachment means such as braces, grips, latches, grooves, insets, threads, or the like, which are designed to permit optimum drilling through pipe 21 by a suitably sized drill bit. Thus, pipe 21, with tool 14 mounted therein, may be attached to the casing/liner string, run into the wellbore, and the entire tubular string cemented in place.

In one presently preferred embodiment, movable inner tubular member 27 is positioned within body member 25. Body member 25 may preferably be substantially tubular and may be cylindrical or at least partially cylindrical. Piston or inner tubular member 27 may be affixed in place by suitable means until movement of tubular member 27 so as to convert operation of conversion tool is desired as explained hereinafter. For instance, tubular member 27 may be held in place or mounted with respect to outer member 25 by one or more shear pins 28, or by other means such as shear bolts, studs, or other breakable members. The breakable members, such as shear pins 28, may be designed to shear or break when a desired lateral force is applied to them (as will be described). Once the breakable members are sheared, then inner tubular member 27 may move or slide with downward longitudinal movement with respect to cylindrical body member 25. Thus, inner tubular member 27 is selectively moveable with respect to outer member 25. The entire float shoe assembly 14, except for member 21, is constructed of frangible material so as to make it drillable after the cementing job is complete.

Outer member 25 and pipe section 21 may also be provided with upwardly facing jet openings 33 [and/or additional up jets 33A]. In one embodiment, up jets 33 [and/or 33A] are initially blocked to prevent fluid flow therethrough in the run in position as shown in FIG. 2 and FIG. 3. Thus, in the run in position, or auto fill position, fluid flow is prevented through openings 33. Moreover, while openings 33 could be formed to direct fluid laterally, downwardly, tangentially, circumferentially, or other any direction, openings 33 are preferably up jets that direct fluid at least partially upwardly. Openings 33 may direct fluid upwardly and outwardly having a vertical and lateral component.

The conversion motion of member 27 discussed above may also be used to uncover the upwardly facing jets 33 [and/or up jets 33A]. Therefore, conversion tool 14 may also permit cement to be directed in a desirable manner so as to be better distributed within the annulus between the casing and borehole wall, such as a distribution equally about all exterior sides of casing string 11 in accord with the present invention. Once pumping stops, then check valves 31 may close automatically. Preferably check valves 31 are spring loaded or biased to the closed position. Thus, a brief release of the pumping pressure from the surface allows valves 31 to close and seat, thus preventing the cement from "u tubing" or "flowing" back into the casing between pump strokes. Valves 31, when activated, thus act as check valves for this purpose.

FIG. 6 and FIG. 7 show another embodiment of the multi-purpose auto fill float shoe 40 of the present invention. Float shoe 40 was designed to maximize reduction of surge pressure when running close-tolerance casing or liners. In this embodiment, a large inside diameter relative to the casing diameter, is provided through passageway 29 along with large diameter valves, and maximum diameter ball sizes. Ball 23 as used in this specification may refer to any drop element such as darts, plugs, rods, and the like. The larger relative internal diameter allows for longer circulation with harsher fluids at greater pump rates. Moreover, the larger internal diameters are less likely to bridge off due to cuttings accumulation. As well, the larger diameter permits more precise conversion pressures [that are factory adjustable from as low as 300 psi to as high as 4000 psi] across the shear mechanism 28 (Fig. 8). Thus, the present invention may permit setting hydraulically activated liner hanger equipment without the need for additional landing collars or setting balls. Once ball 23 is dropped, then the hydraulically activated liner equipment can be operated at a pressure lower than the conversion pressure. After the liner equipment is operated, then conversion of conversion tool 14 can be effected and only one drop ball is used thereby providing more fluid flow during run in due to few restrictions. In fact, this process could be used to operate any other hydraulic equipment in tubular string 11 and multiple sets of hydraulic equipment, which may or may not operate at different pressures, if desired.

In this embodiment, conversion tool 14 is mounted within pipe 21 of float shoe 40 between upper shoulder 42 and lower shoulder 44. If desired, internal diameter 43 may be somewhat enlarged as compared to internal diameter 45 to thereby provide a ledge or grip to support shoulder 42. As well, annular region 47 may be filled in with cement or other material if necessary as discussed above for supporting conversion tool 14 and/or providing a seal between ports 33 and 30 so that the ports may be separately operated as discussed hereinbefore. If no fill material is used within region 47, then an appropriate seal, which may be an O-ring seal or any other type of suitable seal may be used for sealing between ports 33 and 30. Moreover, the outer diameter of conversion tool 14 may be enlarged to fill in region 47 if desired. Lower shoulder 44 is formed on nose element 46 which may be comprised of drillable material such as aluminum. Conversion tool may be inserted into tubular 21 and nose element then attached thereto. Since conversion tool 14 is securely supported by upper shoulder 42 and lower shoulder 44, then little or no cement/glue or other materials are required to secure conversion tool 14 with respect to pipe 21 thereby permitting for a larger useable internal diameters. This embodiment also provides up jets 33 and down jets 30, as discussed hereinbefore. In FIG. 6, sleeve 27 is in the run in position for auto fill. In FIG. 7, drop ball 23, which may for instance be a two inch diameter drop ball or whatever a sufficient size to enable running some such, has engaged and sealed seat 35 so that sleeve 27 is forced to the converted position as discussed hereinbefore. This embodiment also provides for a double-valved float shoe with two large diameter valves 31.

FIG. 8 and FIG. 9 show another embodiment of the present invention in the form of float collar 40A which also comprises a double valve float equipment configuration formed within tubular collar section 21A which may have upper and lower threads thereon for insertion into the casing/liner string such as one or more joints above the bottom. Valves 31 and seats 31A are protected by sleeve 27 as discussed hereinbefore. Conversion tool 14 may be mounted by any suitable means within collar section 21A. Float collar 40A may be used in conjunction with guide shoe 50, one example of which is shown in FIG. 10. Float collar 40A may also be used in conjunction with other guide shoes and other tubular members with down jets or up jets to be controlled. A float collar configuration, such as float collar 40A allows for a one or two joint casing shoe track below the float collar, and is more tolerant of large amounts of cuttings entering casing string 11. In FIG. 8, float collar 40A is in the run in position which permits auto fill and/or circulation when desired. In FIG. 9, float collar 40A has been converted to back pressure operation whereby valves 31 are activated. [Landing seat section 42 may be used for sealing downwardly oriented jets and/or center bore 54 as discussed hereinbefore.]

In the particular embodiment disclosed for use with float collar 40A, but not necessarily in all embodiments, up jets 52 are positioned within guide shoe 50. Moreover, if desired, center bore 54 can be selectively sealed off such as with aluminum cover or rod 56. Aluminum cover or rod 56 or any other suitable fragile material may be designed to be breakable so that with sufficient pressure, center bore 54 can be used for downward washing and/or auto fill purposes.

In general, it will be understood that such terms as "up," "down," "vertical," and the like, are made with reference to the drawings and/or the earth and that the devices may not be arranged in such positions at all times depending on variations in operation, transportation, mounting, and the like. While some boreholes are substantially horizontal rather than vertical, down is considered to be directed downhole or towards the bottom of the hole. Up is considered the direction in the hole that leads to the surface. As well, the drawings are intended to describe the concepts of the invention so that the presently preferred embodiments of the invention will be plainly disclosed to one of skill in the art but are not intended to be manufacturing level drawings or renditions of final products and may include simplified conceptual views as desired for easier and quicker understanding or explanation of the invention. As well, the relative size of the components may be greatly different from that shown. Down jets, for purposes herein are considered to have an acute angle of between zero degrees and less than ninety degrees between the vertical line heading downhole. Down jets may include a purely downward opening, such as the opening in the bottom of the tubular string. Up jets have an obtuse angle [or] <u>of</u> greater than ninety degrees and less than one hundred eighty degrees with respect to the vertical line heading downhole. The up jets and down jets orientation may have a purely vertical component and a purely lateral component or more also include a circumferential component for swirling. The present invention could also be used to operate laterally directed jets, for instance, jets with a ninety degree orientation. Purely circumferentially oriented jets to swirl cement could also be used.

Clean Specifications Sheets

MULTI-PURPOSE FLOAT EQUIPMENT AND METHOD

RELATED APPLICATIONS

This application is a continuation-in-part of United Sates Patent Application Serial Number 09/524,117, filed 13 March 2001 and issued as U.S. Patent No. 6,401,824 on June 11, 2002.

BRIEF DESCRIPTION OF THE PRIOR ART

For instance, in vertical or horizontal boreholes, or sections of a well having vertical and horizontal boreholes, one or more casing strings may be lowered into the hole and anchored therein by pumping a column of cement into the annulus between the casing string and the wall of the borehole. When lowering casing/liner into the wellbore, it has become conventional practice to fill the casing/liner string with drilling fluid. However due to the volume displaced by the tubular string, surge pressure is created during the process of lowering the casing into the fluid filled wellbore. The surge pressure may damage the formation as fluid is highly compressed and forced into the formation. The surge pressure may be especially great when running close tolerance casings or liners. While devices have been used to permit fluid flow into the casing as it is lowered to thereby reduce surge pressure, problems may still occur due to limited internal casing diameters that restrict the volume of fluid flow and/or restrictions in the casing internal diameter due, for instance, to the internal diameter of float valves in the float equipment. Moreover, cuttings from the well bore may collect and bridge, for instance adjacent restrictions in the casing string, to create additional problems. Moreover, damage may occur to internal elements such as hydraulically activated liner hanger equipment, float valves, sealing elements such as seats for the float valves, or other elements, due to the abrasive fluids or cuttings from the wellbore that flow into the casing string.

SUMMARY OF THE INVENTION

Thus, the apparatus of the present invention may comprise a float shoe or float collar that incorporates a check valve, or a plurality of such valves, which can allow the casing to fill up from the bottom with well fluid (auto fill) during run in. Below the valve, or valves, may be a center outlet hole as well as both upwardly and downwardly facing jets. In one embodiment, a tube inside the float shoe holds the flapper or check valve(s) open to allow fluid into the casing or to permit circulation. This same tube also covers and closes a set of upwardly facing jets during run in. The downwardly facing jets are open to aid in washing the borehole wall during the casing run in or float in. Once the casing string has reached the desired depth, a drop member such as an obscuration ball may be pumped down the casing. The ball seats in the float shoe or float collar tube. With an increase in pumping pressure from the surface, the seated ball then causes the float shoe or float collar tube to move downwardly inside the tool. The downward movement allows the check valve(s) or flappers to swing closed, thus activating the check valve(s). When the tube shifts downwardly it closes and shuts off the downwardly facing jets and exposes, or opens, the upwardly facing jets to assist in cement distribution, during the cementing operation, to all sides of the casing.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

At some time during the well completion operation, it may be desirable to drill out tool 14. Therefore, conversion tool 14 should preferably be comprised of drillable materials. As well, the mounting of conversion tool 14 within pipe 21, which may effected in different ways, should preferably be drillable such as with a drill bit that may also be used for continuing to drill into the well bore formation. Generally, the drill bit will be as large as practical to fit through casing 21 and may have an outer diameter within one-quarter inch of the inner diameter of casing 21. In this example, tool 14 may be cemented, molded, or otherwise mounted within a short piece of pipe 21. Materials such as cement, concrete, plastics, aluminum, and the like which are easily drillable may be utilized for mounting tool 14 within pipe 21. In FIG. 2, details of one possible installation of tool 14 within short pipe section 21 are shown. Short pipe section 21 may be provided with interior teeth, grips, ridges, threads, roughed region, or grooves 26 to enhance attachment of material 21A to pipe 21. Material 21A may include any material useful in providing a sturdy but drillable attachment between tool 14 and pipe 21 such as but not limited to cement, plastics, glues, composite materials, elastomerics, fibers, or combinations of the above, or other suitable materials Thus, cylindrical body member 25 of tool 14 is held in place by material 21A and/or other attachment means such as braces, grips, latches, grooves, insets, threads, or the like, which are designed to permit optimum drilling through pipe 21 by a suitably sized drill bit. Thus, pipe 21, with tool 14 mounted therein, may be attached to the casing/liner string, run into the wellbore, and the entire tubular string cemented in place.

In one presently preferred embodiment, movable inner tubular member 27 is positioned within body member 25. Body member 25 may preferably be substantially tubular and may be cylindrical or at least partially cylindrical. Piston or inner tubular member 27 may be affixed in place by suitable means until movement of tubular member 27 so as to convert operation of conversion tool is desired as explained hereinafter. For instance, tubular member 27 may be held in place or mounted with respect to outer member 25 by one or more shear pins 28, or by other means such as shear bolts, studs, or other breakable members. The breakable members, such as shear pins 28, may be designed to shear or break when a desired lateral force is applied to them (as will be described). Once the breakable members are sheared, then inner tubular member 27 may move or slide with downward longitudinal movement with respect to cylindrical body member 25. Thus, inner tubular member 27 is selectively moveable with respect to outer member 25. The entire float shoe assembly 14, except for member 21, is constructed of frangible material so as to make it drillable after the cementing job is complete.

Outer member 25 and pipe section 21 may also be provided with upwardly facing jet openings 33. In one embodiment, up jets 33 are initially blocked to prevent fluid flow therethrough in the run in position as shown in FIG. 2 and FIG. 3. Thus, in the run in position, or auto fill position, fluid flow is prevented through openings 33. Moreover, while openings 33 could be formed to direct fluid laterally, downwardly, tangentially, circumferentially, or other any direction, openings 33 are preferably up jets that direct fluid at least partially upwardly. Openings 33 may direct fluid upwardly and outwardly having a vertical and lateral component.

The conversion motion of member 27 discussed above may also be used to uncover the upwardly facing jets 33. Therefore, conversion tool 14 may also permit cement to be directed in a desirable manner so as to be better distributed within the annulus between the casing and borehole wall, such as a distribution equally about all exterior sides of casing string 11 in accord with the present invention. Once pumping stops, then check valves 31 may close automatically. Preferably check valves 31 are spring loaded or biased to the closed position. Thus, a brief release of the pumping pressure from the surface allows valves 31 to close and seat, thus preventing the cement from "u tubing" or "flowing" back into the casing between pump strokes. Valves 31, when activated, thus act as check valves for this purpose.

FIG. 6 and FIG. 7 show another embodiment of the multi-purpose auto fill float shoe 40 of the present invention. Float shoe 40 was designed to maximize reduction of surge pressure when running close-tolerance casing or liners. In this embodiment, a large inside diameter relative to the casing diameter, is provided through passageway 29 along with large diameter valves, and maximum diameter ball sizes. Ball 23 as used in this specification may refer to any drop element such as darts, plugs, rods, and the like. The larger relative internal diameter allows for longer circulation with harsher fluids at greater pump rates. Moreover, the larger internal diameters are less likely to bridge off due to cuttings accumulation. As well, the larger diameter permits more precise conversion pressures across the shear mechanism 28 (Fig. 8). Thus, the present invention may permit setting hydraulically activated liner hanger equipment without the need for additional landing collars or setting balls. Once ball 23 is dropped, then the hydraulically activated liner equipment can be operated at a pressure lower than the conversion pressure. After the liner equipment is operated, then conversion of conversion tool 14 can be effected and only one drop ball is used thereby providing more fluid flow during run in due to few restrictions. In fact, this process could be used to operate any other hydraulic equipment in tubular string 11 and multiple sets of hydraulic equipment, which may or may not operate at different pressures, if desired.

In this embodiment, conversion tool 14 is mounted within pipe 21 of float shoe 40 between upper shoulder 42 and lower shoulder 44. If desired, internal diameter 43 may be somewhat enlarged as compared to internal diameter 45 to thereby provide a ledge or grip to support shoulder 42. As well, annular region 47 may be filled in with cement or other material if necessary as discussed above for supporting conversion tool 14 and/or providing a seal between ports 33 and 30 so that the ports may be separately operated as discussed hereinbefore. If no fill material is used within region 47, then an appropriate seal, which may be an O-ring seal or any other type of suitable seal may be used for sealing between ports 33 and 30. Moreover, the outer diameter of conversion tool 14 may be enlarged to fill in region 47 if desired. Lower shoulder 44 is formed on nose element 46 which may be comprised of drillable material such as aluminum. Conversion tool may be inserted into tubular 21 and nose element then attached thereto. Since conversion tool 14 is securely supported by upper shoulder 42 and lower shoulder 44, then little or no cement/glue or other materials are required to secure conversion tool 14 with respect to pipe 21 thereby permitting for a larger useable internal diameters. This embodiment also provides up jets 33 and down jets 30, as discussed hereinbefore. In FIG. 6, sleeve 27 is in the run in position for auto fill. In FIG. 7, drop ball 23, which may for instance be a two inch diameter drop ball or whatever a sufficient size to enable running some such, has engaged and sealed seat 35 so that sleeve 27 is forced to the converted position as discussed hereinbefore. This embodiment also provides for a double-valved float shoe with two large diameter valves 31.

FIG. 8 and FIG. 9 show another embodiment of the present invention in the form of float collar 40A which also comprises a double valve float equipment configuration formed within tubular collar section 21A which may have upper and lower threads thereon for insertion into the casing/liner string such as one or more joints above the bottom. Valves 31 and seats 31A are protected by sleeve 27 as discussed hereinbefore. Conversion tool 14 may be mounted by any suitable means within collar section 21A. Float collar 40A may be used in conjunction with guide shoe 50, one example of which is shown in FIG. 10. Float collar 40A may also be used in conjunction with other guide shoes and other tubular members with down jets or up jets to be controlled. A float collar configuration, such as float collar 40A allows for a one or two joint casing shoe track below the float collar, and is more tolerant of large amounts of cuttings entering casing string 11. In FIG. 8, float collar 40A is in the run in position which permits auto fill and/or circulation when desired. In FIG. 9, float collar 40A has been converted to back pressure operation whereby valves 31 are activated.

In the particular embodiment disclosed for use with float collar 40A, but not necessarily in all embodiments, up jets 52 are positioned within guide shoe 50. Moreover, if desired, center bore 54 can be selectively sealed off such as with aluminum cover or rod 56. Aluminum cover or rod 56 or any other suitable fragile material may be designed to be breakable so that with sufficient pressure, center bore 54 can be used for downward washing and/or auto fill purposes.

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